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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/627,418	07/27/2000	Tatsuya Usami	00N010-US	1182
21254	7590	01/12/2005	EXAMINER	
MCGINN & GIBB, PLLC 8321 OLD COURTHOUSE ROAD SUITE 200 VIENNA, VA 22182-3817			QUACH, TUAN N	
			ART UNIT	PAPER NUMBER
			2814	

DATE MAILED: 01/12/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/627,418	Applicant(s) USAMI, TATSUYA	
	Examiner Tuan Quach	Art Unit 2814	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 21 October 2004.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,2,4,5 and 14-51 is/are pending in the application.
- 4a) Of the above claim(s) 1,2,4,5 and 14-27 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 28-37 and 39-50 is/are rejected.
- 7) ☒ Claim(s) 38 and 51 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date: _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date: _____ | 6) <input type="checkbox"/> Other: _____ |

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DETAILED ACTION

Claims 28-37 are elected. New claims 38-51 are added. Applicant traverses on the ground that claims are not species. Applicant however fails to show that the species are not patentably distinct and fails to submit evidence or identify such evidence of record that this is the case.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 32-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lopatin or Avanzino and the admitted prior art.

Lopatin (6,096,648) teaches, e.g., column 4 line 60 to column 6 line 61, Figs. 1-8, teaches multilevel interconnection including copper 24 and low

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dielectric constant layer, e.g., layer 30 including HSQ and FLARE, similar materials employed by applicant, thus possessing the ability that Cu is unlikely to enter, the same material employed consistent with applicant's acknowledgement on page 12 lines 1-2 that it is obvious that HSQ has properties of preventing diffusion of Cu and since Lopatin does not show any diffusion. In any event, the material therein is clearly capable of such characteristics since it is the same or similar material used by applicant.

Avanzino (6,121,150) teaches copper interconnect in multilevel interconnection employing low dielectric organic based such as HSQ, parylene. See column 8 line 45 to column 11 line 27, Figs. 1-3(E). The inherent ability would be obvious for the same reasons delineated.

Although the Office is not equipped to measure the particular copper concentration and Lopatin or Avanzino do not recite the particular Cu concentration regarding 10^{19} atoms/cm³ as in claim 32, such would be encompassed in therein since Lopatin or Avanzino are not limited or constrained as to the particular concentration. Such would have been further obvious or inherent in these references given they employ the same processing to form the copper, e.g., plating, column 5 line 20 et seq. In Lopatin, column 10 line 56 in Avanzino, see instant specification, page i lines 1-2. Regarding claims 33 and 36, although the Office is not equipped to measure such concentration, the limitation therein would be inherent and obvious given that the material employed in Lopatin, e.g., HSQ or FLARE, or in Avanzino, delineated above, clearly capable of preventing copper diffusion.

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Regarding claim 34, the insulating layer comprises HSQ is clearly taught as delineated above. Regarding claims 35 and 36, the thickness selection would have been obvious and would have been within the purview of one skilled in the art and given that Lopatin is not limited in its thickness, the thickness taught in Avanzino above, e.g., column 10 line 2, and as 50 nm corresponds to the conventional thickness range for the insulating material,. The direct contact as in claim 37 would have been obvious as shown, e.g., Fig. 7 in Lopatin, and in any event where the adhesion/or barrier is optionally not employed or required.

Claims 39-50 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lopatin or Avanzino and the admitted prior art as applied to claims 32-37, above, and further in view of ~~Zang~~ Zhao.

Regarding claims 39-41, 44, 45, 48, 50, it would have been obvious to have included additional layers, e.g., silicon nitride sandwiching the low k dielectric, including SiN, to employ such structure on copper lines, and to repeat such structures to the desired levels since such correspond to well known structures as admitted, e.g., instant Fig. 9, instant specification pages 1-3, and as shown in Zhao, 6,037,654, Fig. 12, column 5 line 20 to column 9 line 40, including the conventional use of separation, e.g., layer 13, 15 column 6 line 65-9, including material such as silicon nitride; wherein such layer serves useful purposes such as capping or etchstop. In any event, such layers are well known as admitted by applicant above.

With regard to the adhesion layer and W as such layer in these claims, such would have been conventional and obvious given that the layers in Lopatin

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and Avanzino clearly capable of adhering, e.g., layer 54, and in Avanzino, layer 11, column 10 line 54-68 evidencing the various materials as adhesion and barriers including refractory metals such encompassing tungsten. Additionally, Zhao (6,037,664) teaches various the conventional use of liner in conjunction with copper wherein the barrier also provides adhesion, including the use of tungsten for such material. See column 4 lines 52 to column 5 line 25. 33. The provision of openings 24 and 25 in various low dielectric constant material, e.g., layer 14, followed by copper conductor, e.g., 29 including barrier/adhesion is also shown. See column 6 lines 10 to column 8 line 45.

It would have been obvious to one skilled in the art at the time the invention was made in practicing the above invention to have included the tungsten barrier/adhesion layer in question if desired to improve adhesion/barrier characteristic in the copper interconnect as evidenced by Zhao.

Claims 28–31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Lopatin or Avazino taken with the admitted prior art and Zhao or Subramanian.

Lopatin or Avazino are applied as above and do not show the second insulating layer. Such second insulating layer correspond to the additional insulating layer well known as admitted by applicant as delineated above, e.g., Fig. 9 including the layers of silicon nitride on the low k dielectric. Such would have been conventional and obvious as evidenced by Zhao above, wherein the additional insulating layer would serve to provide separation as delineated above. In addition, Subramanian (6,127,089) teaches the use of additional layer 44 on

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the low k dielectric 42, e.g., column 1 line 45 and sequec., column 5 line 23 to column 8 line 40, wherein the additional layer, e.g., layer 54/55, 64/65, 62/63 wherein such layer would facilitate patterning of the insulating layer, e.g., wherein such layer can be employed as mask in patterning. See, e.g., column 5 line 25 to column 6 line 65. It would have been obvious to one skilled in the art to have employed the additional layer since such correspond to conventional multiple insulating layers and is advantageous for separation or for patterning. The Cu I would be unlikely to enter given the materials employed and that the same or similar materials are employed by applicant. Regarding claims 29-31, the concentration would be met or obvious for the same reasons delineated above, e.g., claim 33-35.

Claims 38 and 51 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. The HSQ/PAE/HSQ structure in these claims are not taught in the prior art.

Applicant's arguments with respect to claims 28-37, 38-50 have been considered but are moot in view of the new ground(s) of rejection.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Quach whose telephone number (571) 272-1717. The examiner can normally be reached on M - F from 8 to 4.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor Wael Fahmy can be reached on (571) 272-1705. The fax

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phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (571) 272-1562.



Tuan Quach
Primary Examiner